

surrounding the portion of the substrate.

US 5,712,932 describes optical cross connects for routing optical traffic between transmission paths in a wavelength-division-multiplexed optical communication system. The cross-connect switches in the '932 patent use Bragg grating filters.

Applicants have discovered that conventional double-stage acousto-optical devices require excessive substrate size and incur signal losses in their arrangement as add/drop multiplexers or wavelength selective cross-connects. The larger wafer size and additional connections and losses leads to unnecessary complexity and cost for wavelength selection using acousto-optical techniques.

### SUMMARY OF THE INVENTION

Applicants have discovered that add/drop multiplexers and optical cross-connect switches that use acousto-optical devices can have smaller wafer size, shorter length, fewer optical fiber connections and better performance than that used in conventional devices.

In one aspect, an acousto-optical add/drop multiplexer consistent with the present invention includes a substrate-mounted acousto-optical switch having a first optical port coupled to a first polarization splitter, first and second polarization conversion regions optically coupled between the first polarization splitter and a second polarization splitter, and second and third optical ports coupled to the second polarization splitter. The multiplexer includes a first circulator having an input port, a switch port coupled to the first optical port, and an output port. A reflecting device is coupled to the second optical port of the switch.

Preferably, the multiplexer further includes a second circulator having a filter port coupled to the third optical port, a drop port, and an add port.

Preferably, the first polarization splitter has cross and bar transmission respectively for orthogonal polarization components of received light.

Preferably the second polarization splitter has cross and bar transmission respectively for orthogonal polarization components of received light.

In an embodiment, the multiplexer also includes a polarization-mode-dispersion compensator coupled between the reflecting device and the second optical port of the switch. Preferably, the polarization-mode-dispersion compensator is a birefringent element, such as one of a polarization-maintaining fiber, and a

birefringent crystal. Alternatively, the polarization-mode-dispersion compensator comprises a Faraday rotator or a quarter wave plate.

In an alternative embodiment, a first polarization-mode-dispersion compensator is coupled between the filter port of the second circulator and the third  
5 optical port of the switch, and a second polarization-mode-dispersion compensator is ~~coupled between the switch port of the first circulator and the first optical port of the~~ switch. Preferably, the first and second polarization-mode-dispersion compensators are one of a polarization-maintaining fiber and a birefringent crystal.

In another aspect, a wavelength selective optical cross-connect consistent  
10 with the present invention includes at least two acousto-optical switches, each including a first polarization splitter, a wavelength-selective polarization conversion stage coupled between the first polarization splitter and a second polarization splitter, a reflecting device coupled to one arm of the second polarization splitter, and a  
15 circulator having an input port for receiving line channels, a switch port coupled to the first polarization splitter, and an output port. The cross-connect further includes an optical path coupling second arms of the second polarization splitters in the respective acousto-optical switches.

In yet another aspect, an acousto-optical waveguide device selective in wavelength consistent with the present invention includes a birefringent and  
20 photoelastic substrate, a wavelength-selective polarization conversion region including first and second acoustic waveguides and first and second optical paths, a first polarization splitter coupled between one end of the first and second optical paths and only a first optical interface for the device, and a second polarization splitter. The second polarization splitter has input arms coupled to an opposite end of the first and  
25 second optical paths, a first output arm coupled to a second optical interface for the device and a second output arm. The acousto-optical waveguide device further comprises a reflecting device coupled to the second output arm of the second polarization splitter.

In another aspect, a method of using an optical device includes providing a  
30 plurality of optical channels to an acousto-optical switch having a first polarization splitter and a polarization conversion stage connected between the first polarization splitter and a second polarization splitter, switching at least one of the optical channels to a first arm of the second polarization splitter and other of the optical channels to a second arm of the second polarization splitter, reflecting the other of the